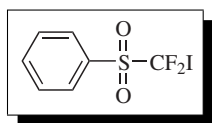


Iododifluoromethyl Phenyl Sulfone



[802919-90-0] $C_7H_5F_2IO_2S$ (MW 318.08)
 InChI = 1/C7H5F2IO2S/c8-7(9,10)13(11,12)6-4-2-1-3-5-6/h1-5H
 InChIKey = LIPDDCLPIKKOTB-UHFFFAOYAT

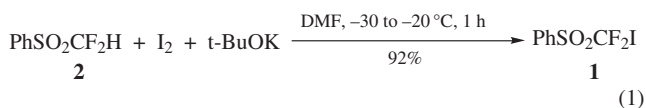
(radical (phenylsulfonyl)difluoromethylating agent;¹ difluorocarbene precursor²)

Physical Data: colorless solid; readily turns to red under light.¹
Solubility: sol alcohols, ethers, CH_2Cl_2 , $CHCl_3$, benzene, toluene, acetonitrile, DMF, DMSO.

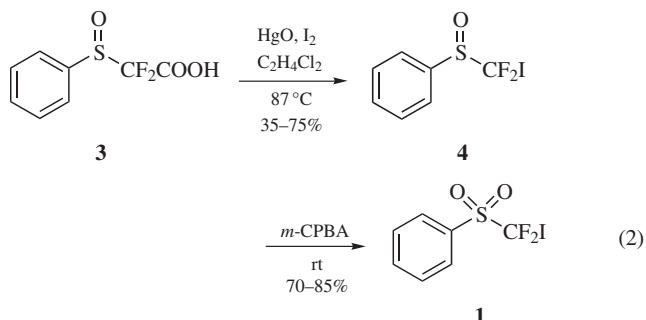
Form Supplied in: colorless solid; readily turns to red under light; often prepared by the reaction between difluoromethyl phenyl sulfone and iodine in the presence of a base, such as potassium *tert*-butoxide in DMF.¹

Handling, Storage, and Precautions: $PhSO_2CF_2I$ has high reactivity with bases, nucleophiles, reducing agents, and radical initiators; keep away from heat and light; store under anhydrous, neutral conditions in dark; use in a fume hood.

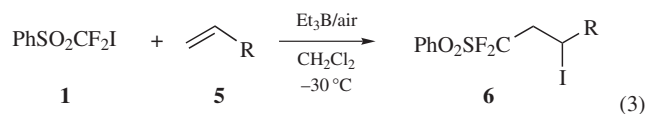
Preparation of Iododifluoromethyl Phenyl Sulfone. Unlike most fluoroalkyl iodides that usually need much effort to prepare, iododifluoromethyl phenyl sulfone ($PhSO_2CF_2I$, **1**) can be easily prepared in excellent yield (92–95%) by reacting difluoromethyl phenyl sulfone (**2**) with elemental iodine in the presence of *t*-BuOK in DMF solution (eq 1).^{1,2} The success of this simple preparation can be ascribed to the good nucleophilicity of the in situ-generated $PhSO_2CF_2^-$ carbanion that derives from deprotonation of $PhSO_2CF_2H$.^{1–3} This simple preparative method enables compound **1** to be a readily available chemical for many further useful applications.



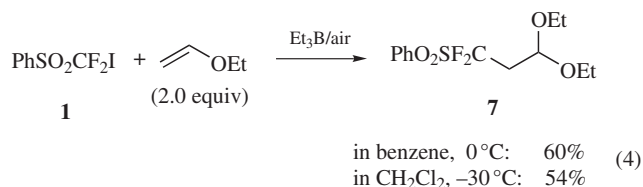
Iododifluoromethyl phenyl sulfone (**1**) can also be prepared by a Borodin–Hunsdiecker reaction followed by oxidation (eq 2).⁴ The in situ-formed mercury salt of phenylsufinyldifluoroacetic acid (**3**) reacts with iodine giving phenylsufinyldifluoromethyl iodide (**4**), which can be further oxidized by *m*-chloroperbenzoic acid (*m*-CPBA) to give product **1**.⁴



Free-radical (Phenylsulfonyl)difluoromethylation. Iododifluoromethyl phenyl sulfone (**1**) can be used as a free-radical (phenylsulfonyl)difluoromethylating agent.² Triethylborane (Et_3B)/air is a good initiating system for the reaction between **1** and terminal alkenes **5** (eq 3), while Cu^0 and $Pd(PPh_3)_4$ are not efficient to initiate the reaction. The reactions proceed smoothly to give the regioselective products **6** in satisfactory to good yields, with the reaction being compatible with different functionalities such as carbonyl, ester, carboxylic acid, ether, and hydroxyl groups. It is interesting that the reaction between **1** and vinyl ethyl ether gives the acetal **7** as the product (eq 4), possibly via an oxonium ion intermediate.²

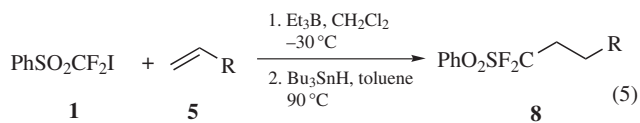


R	Product yield (%)
1-butyl	75
1-decyl	72
trimethylsilyl	71
$CH_3C(O)CH_2CH_2$	70
$EtOC(O)CH_2CH_2CH_2$	78
$HO_2CCH_2CH_2$	73
$HOCH_2$	64
<i>p</i> - $CH_3OC_6H_4OCH_2-$	56

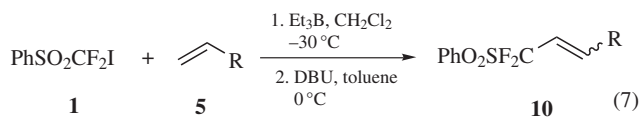
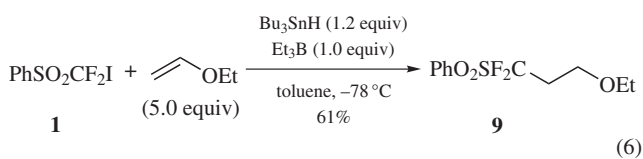


Iododifluoromethyl phenyl sulfone (**1**) can also be applied in one-pot two-step procedure to accomplish a clean (phenylsulfonyl)difluoromethylation of alkenes, using Bu_3SnH reagent to facilitate the deiodination reaction (eq 5).² This one-pot two-step procedure proceeds smoothly giving the (phenylsulfonyl)difluoromethylated alkanes **8** in 57–78% isolated yields, with good toleration of several types of functional groups. This one-pot approach is a good alternative for the previously reported preparative method for product **8** under strong basic conditions.^{5,6} Furthermore, this reaction also works for vinyl ethyl ethers (eq 6). In the presence of Bu_3SnH and Et_3B , the reaction between **1** and excess amount of vinyl ethyl ether (5 equiv) in toluene at $-78^\circ C$ gave the corresponding product **9** in 61% isolated yield (eq 6).²

Iododifluoromethyl phenyl sulfone (**1**) has also been used in the one-pot two-step stereoselective preparation of (phenylsulfonyl)difluoromethylated 1,2-disubstituted alkenes **10** (eq 7).² 1,5-Diazabicyclo [4.3.0]non-5-ene (DBU) was found to be a good base for the reaction, and in the nonpolar solvent toluene at $0^\circ C$, excellent *E/Z* ratios (up to 100:1) of products **10** were observed (eq 7).

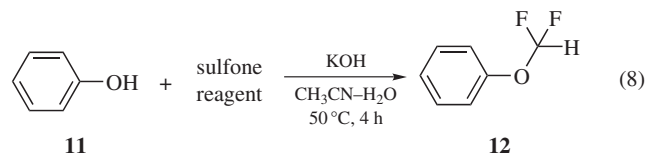


R	Product yield (%)
1-butyl	75
1-decyl	70
trimethylsilyl	65
$\text{CH}_3\text{C}(\text{O})\text{CH}_2\text{CH}_2-$	69
$\text{EtOC}(\text{O})\text{CH}_2\text{CH}_2\text{CH}_2-$	78
$p\text{-CH}_3\text{OC}_6\text{H}_4\text{OCH}_2-$	57



R	Product yield (%)	E/Z
1-butyl	71	64:1
1-decyl	69	70:1
trimethylsilyl	69	51:1
$\text{CH}_3\text{C}(\text{O})\text{CH}_2\text{CH}_2-$	61	38:1
$\text{EtOC}(\text{O})\text{CH}_2\text{CH}_2\text{CH}_2-$	68	60:1
HOCH_2-	58	56:1
$p\text{-CH}_3\text{OC}_6\text{H}_4\text{OCH}_2-$	55	$\geq 100:1$

Use as a Difluorocarbene Precursor. Iododifluoromethyl phenyl sulfone (**1**) can also be used as a difluorocarbene precursor for difluoromethylation of phenols (eq 8).⁷ When phenol (**11**), compound **1**, and KOH were admixed (with a molar ratio **11**/**1**/KOH = 1:2.3:11) in $\text{CH}_3\text{CN-H}_2\text{O}$ at 50°C , the difluoromethylated product **12** was obtained in 25% yield. Interestingly, the use of chlorodifluoromethyl phenyl sulfone (**13**) and bromodifluoromethyl phenyl sulfone (**14**) can give better yields than the use of **1** (eq 8).⁷



Sulfone reagent	Product yield (%)
$\text{PhSO}_2\text{CF}_2\text{Cl}$ (13)	72
$\text{PhSO}_2\text{CF}_2\text{Br}$ (14)	70
$\text{PhSO}_2\text{CF}_2\text{I}$ (1)	25
$\text{PhSO}_2\text{CF}_2\text{H}$ (2)	23
PhSO_2CF_3 (15)	0

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